WEST AFRICAN COCOA RESEARCH INSTITUTE

QUARTERLY PROGRESS REPORT

No. 46

TAFO, ~~GOLD COAST~~ GHANA.

COMMONWEALTH MYCOLOGICAL INSTITUTE
10 OCT 1957

PRINTED BY THE GOVERNMENT PRINTER, ACCRA.

WEST AFRICAN COCOA RESEARCH INSTITUTE

T A F O

FORTY-SIXTH QUARTERLY REPORT : APRIL-JUNE, 1957

SENIOR STAFF

Director	J. Lamb
Deputy Director	C.G. Johnson
Scientific Assistant to Director	G.A. Jones
Secretary	H.L. Pugh
Office Assistant/Librarian	Audrey Bryan
TAFO STATION	
Division of Entomology	D.J. Taylor (on leave 24th April prior to resignation) P.F. Entwistle (on leave 7th May) Joyce M. Hurd (temporary)
Division of Pathology	W.T. Dale (on leave prior to resignation) A.L. Wharton A. Attafuah
Division of Botany	A.D. McKelvie (returned from leave 17th April) D.R. Glendinning R.G. Hurd
Division of Chemistry	T.A. Rohan E. Margaret Holden P.W. Arnold (on leave 22nd May, pending termination of secondment) R.K. Cunningham
Division of Agronomy	R.J. Benstead
Plantations Manager	H.W.S. Allison
Maintenance Engineer	A. Maddison (arrived 30th April)
Guide-Demonstrator	F.E. Decker
Station Manager	S.E. Ntim Kwafo (on leave 3rd June)
IBADAN SUB-STATION	
Entomologist (Acting Officer-in-Charge)	R.G. Donald
Pathologists	J.M. Thresh (on leave 20th May) D. Kay (arrived 3rd April).

STAFF MATTERS

The Director left Tafo on the 14th April for a three-week tour of cacao-growing areas in Nigeria and the Cameroons. Mr. Glendinning also visited Nigeria in April to arrange the planting of variety trials in Eastern and Western Regions, while Mr. Wharton and Mr. Donald spent two weeks in the Cameroons during June studying leafless-twig disease of cacao.

Mr. D. Kay, mycologist, joined the staff of the Sub-Station in April. Mr. A. Maddison arrived at Tafo in April to take up his duties as Maintenance Engineer, and he has now taken over the Maintenance Division.

VISITORS

Sir Robert MacLennan, U.K. High Commissioner in Ghana, accompanied by Mr. Jenkyns of the U.K. Treasury, visited the Institute on 3rd April. During his visit to Ghana in April Mr. Alport, Permanent Under-Secretary of the Commonwealth Relations Office, London, spent a day at Tafo. In May the Institute was visited by Mr. David Owen, Chairman of the United Nations Technical Assistance Board. Other visitors have included Mr. D. Rhind of the Colonial Office; Miss Hella Pick of "West Africa"; Mr. R.W.B. Carter, U.K. Trade Commissioner in Ghana; Mr. K. Wilson-Jones, Colonial Pesticides Research; Dr. Risbec, Scientific Secretary, Inter-African Phyto-Sanitary Commission; Mr. Van der Ploeg, F.A.O; Dr. Orellana, Plant Pathologist, F.A.O; and members of the Western Region Cocoa Marketing Board, Nigeria.

MANAGEMENT AND MAINTENANCE

Clearing has continued on the sites for the new bungalows at Tafo. A contract for the construction of the bungalows has been awarded, and the work has started at two sites.

Clearance work has also started in preparation for a new fermenting and drying shed near the laboratories.

CROP DELIVERY

A small minor-crop developed during early May, at least a month sooner than is usual with Amelonado cacao. It was particularly noticeable on the younger cacao in the experimental areas. During the quarter 51,512 pods were harvested.

SWOLLEN SHOOT DISEASE

The number of trees removed from the Uniformity Trial Areas during the quarter, due to virus infection and other causes, is shown in the following table.

Month	Trees destroyed		Total
	Swollen Shoot	Undiagnosed	
April	56	14	70
May	58	11	69
June	66	11	77
Total	180	36	216

UPPER AMAZON SEED

A total of 5,680 F3 pods were despatched to Nigeria during the quarter.

METEOROLOGY

Month	1957		19-year mean	
	Rainfall (in.)	Wet days	Rainfall (in.)	Wet days
April	11.99	15	5.81	11.1
May	8.30	18	7.02	13.8
June	10.65	23	8.36	18.6
Total	30.94	56	21.19	43.5

TAFO STATION

PATHOLOGY DIVISION

VIRUS RESEARCH

Host range of cacao-virus isolates

Tests to determine the persistence of cacao-virus isolates in alternative hosts have continued. The results to date apply only to hosts which have not been coppiced. Bosumtwe virus was recovered from Cola chlamydantha K. Schum. 9 months after infection, Offa Igbo from Sterculia tragacantha Lindl. after 31 months, Alaparun from Heliocarpus popayanensis H.B.K. and S. rhinopetala K. Schum. after 18 and 28, respectively, Bisa from both Herrania balaensis Preuss. and H. sp. 'A' (indet.) after 35, severe New Juaben from Abroma augusta L. f., S. appendiculata K. Schum. ex Engl. and C. gigantea A. Chev. var. grabescens Brenan & Keay after 21, 18 and 21, respectively, and Kpeve virus from Hildegardia barteri (Mast.) Kosterm. after 34 months and from Sterculia rhinopetala K. Schum. after 20.

Hildegardia barteri has not yielded Bisa, Mampong, Alaparun or Offa Igbo isolates after 32, 34, 32 or 42 months, respectively, nor could Bisa, Bosumtwe or Bosomuoso (2) be recovered from either C. gigantea or C. lateritia K. Schum. var. maclaudi (A. Chev.) Brenan & Keay after periods varying between 40 and 46 months.

Bombax costatum Pellegr. & Vuillet was experimentally infected with the Nigerian cacao-virus isolate from Offa Igbo.

Specimens of C. gigantea growing at Tafo are being tested for natural infection and for this purpose material from 11 trees has so far been collected. More than a third of the cuttings collected from baobab trees (Adansonia digitata L.) in eastern (Trans-Volta/Togoland) and north-eastern parts of Ghana (cf. Quarterly Report No. 44) died before producing any leaves on which tests for natural virus infection could be made. It is unfortunate that the material involved included some from trees showing very suspicious symptoms. Apart from the tree at Agboleve, none of the others from which suitable test material was obtained proved to be infected.

Since the field survey for natural infection in baobabs started it has not proved possible to root, and consequently maintain, any of the material collected. When testing these trees for virus infection fresh leaves are the best material on which to feed the mealybugs. When leaves are

not available the cuttings are planted, but they normally produce only a small number of leaves and then die. Of more than 2,000 cuttings planted from recent collections none has produced roots although a third of this number was treated with a rooting hormone before planting.

Transmission Studies

Planococcus kenyae (Le Pelley) has experimentally transmitted Adansonia virus AD7 and the Bosumtwe and Mampong cacao-virus isolates.

Classification and comparison of isolates

In continued immunological relationship tests between isolates, mild Osino from Ghana failed to protect Amelonado cacao seedlings against subsequent infection with the Ghanaian isolates from New Juaben, Bosumtwe and Kpeve, and the Nigerian one from Alaparun. In the same experiments, mild New Juaben gave protection against Sedi Nkawie from Ashanti.

Material collected from discrete outbreaks in the experiments on Swollen Shoot Control (cf. Quarterly Report No. 45) shows that the New Juaben isolate occurs as far north as Kankan. Other isolates which, from present evidence, appear to be mild occur near Abompe, Kwabeng and Mmuoso, in the Osino, Kwabeng and Anyinam cacao areas, respectively.

After 9 months, one of three seedlings infected at the bean stage with the Worawora isolate, using Ps. njalensis as vector, has shown very faint and narrow red vein banding for the first time. Previous to this swellings were the only symptoms recorded for this isolate.

In studies to determine the relative virulence of selected cacao viruses in seedlings (cf. Quarterly Report No. 44, p.7), height measurements taken three months after planting as beans showed a reduction in growth rate of the infected seedlings. As might be expected, the virus isolates which are most virulent in the mature plant also had the greatest effect on seedling growth. The third replicate is being 'harvested' and the fourth will be due for recording next August.

The experiments to compare resistance and tolerance to New Juaben and Kpeve viruses of selected F1 T17 (Iquitos) seedling trees have been continued (Ann. Rep. WACRI, 1955-56). Since swellings are not a symptom of the Kpeve isolate a slightly modified system for scoring resistance and tolerance is employed. Daily observations are being made so that evanescent leaf

symptoms are not missed. Infestation of cuttings in the 2nd and 3rd replicates is in progress.

Chemotherapy

An experiment to determine the effect on the subsequent development of virus symptoms of using different numbers of mealybugs for infecting cacao seedlings, both with and without treatment with thiouracil, has given unsatisfactory results. Three weeks after bombardment symptoms suggestive of virus infection were much more obvious in the plants of the thiouracil-treated groups than in those of the control groups. However, a fortnight later the symptoms were much less definite.

In the next two flushes leaves of both thiouracil-treated and untreated seedlings were frequently mottled and distorted and these symptoms were at first confused with those of virus infection. The distortion was somewhat similar to that found when cacao seedlings are grown in water culture at a high pH or with a combined iron and manganese deficiency. However, a nutrient deficiency did not seem probable and the symptoms were not the same as those of any known cacao virus. Similar abnormalities were observed on infected and apparently healthy seedlings in a number of other virus experiments. The possibility is now being investigated that the effects were caused by the gamma-BHC preparation which had been used instead of nicotine for spraying the insectaries. When the experiment was terminated few of the plants had obvious symptoms of virus infection and back-tests to cacao beans have so far shown that comparatively few of the plants were definitely infected. The experiment is being repeated.

STUDIES ON BLACK-POD DISEASE

Pod inoculation techniques

Work on the development of a standard technique for inoculating unwounded cacao pods with Phytophthora palmivora has continued. Different methods of inoculating both wounded and undamaged pods have been tested to ascertain the conditions necessary for infection. Spore suspensions applied to pods previously rubbed with an abrasive gave multiple infections, suggesting that germinating spores require entry points through the pod cuticle. Undamaged pods are therefore being tested under conditions likely to promote maximum stomatal opening, i.e.

bright sunlight and a surrounding atmosphere low in carbon dioxide. Rapid penetration of organic solvents is being used as a test for open stomata.

Results from these preliminary experiments have been promising. They have shown that adequate aeration of sporangial suspensions is essential for the production of active zoospores. Several authorities have stressed the importance of low temperatures around 71°F for indirect sporangia germination, but this does not apparently hold at Tafo. With adequate aeration sporangia readily produced zoospores at temperature up to 84°F, and germination of the zoospores themselves was 95-100 per cent complete. Such suspensions have given varying numbers of multiple infections with undamaged pods.

Resistance and tolerance

Investigations on inoculation techniques and strains of P. palmivora are ultimately concerned with the experimental testing of cacao selections for resistance and/or tolerance to black-pod disease.

Studies have meanwhile started on the susceptibility of cacao types grown at Tafo to natural infection in the field, and the 1st Clonal Trial has been designated a Pod Disease Resistance Experiment. Previous records taken by the Botany Division suggested that the susceptibility to infection of some selections in this trial differed significantly from the mean. Every effort is being made to allow black-pod disease to build up in this area to afford a more accurate comparison between the various selections. Harvesting has been reduced to six-weekly intervals and more accurate pod disease records are now being taken. After recording, diseased pods are labelled and left on the trees, except where the primary pathogen cannot be determined when pods are examined in the laboratory and if necessary isolates are taken. The plots are inspected twice weekly to ensure that cherelle infections are not missed.

Individual tree records of diseased pods from the earliest years of bearing are also being collected from all trees in the 9th Progeny Trial. Because of the importance of yield records from these trees they are harvested every week and in consequence the incidence of black-pod disease has so far been negligible.

P. palmivora on cacao in the British Cameroons

A visit was made to the British Cameroons to investigate a report that P. palmivora might be associated with "Leafless Twig Disease" of cacao. There was no evidence for the infection of the "leafless twigs" themselves nor could any pathogen be isolated from seedlings and chupons showing "paint-brush" symptoms before jorquetting.

A common tip necrosis of flush leaves on the mature cacao at Tombel is possibly not a nutrient deficiency, as reported by previous investigators. The wet rot advances from the tip more rapidly along the main and secondary veins often preceded by a translucent colourless band of tissue. Using various isolation methods and five different culture media a species of Colletotrichum was invariably isolated from the necrotic areas; P. palmivora was also seen and collected from the surface of affected tissue but was never isolated. This is the first record for West Africa of P. palmivora occurring naturally on leaves of mature cacao. Symptoms of the disorder were produced on a healthy flush by spraying with a mixed suspension of Colletotrichum and Phytophthora spores but limited time and equipment precluded further experiments. From these observations it can only be suggested that this necrosis may be pathogenic in origin.

ENTOMOLOGY DIVISION

CAPSID STUDIES

Capsid Biology

Capsid population levels at different times of the year and their association with changing weather continue to be observed: this shows the pattern of population change but the causes are not understood. The two important species, S. singularis and D. theobroma, are usually at their lowest numbers from February to May and at their highest from August to November or December, though there are variations in this. Moreover D. theobroma usually has a double maximum, separated by an interval of about 2-3 months. The increase in number from minimum to maximum seems to be of the order of 30 to 40 times with Sahlbergella and from 7 to 10 times with Distantiella: the sampling methods, however, which may introduce large errors, need investigation and refinement.

Joint WACRI and Department of Agriculture Capsid Control Trials 1957

Preliminary trials in 1956 aimed to compare the effectiveness of mistblown, aqueous emulsions of Endrin, Aldrin, Dieldrin, Gammalin and Heptachlor (see WACRI Quarterly Report No. 45). No statistically significant differences in performance were detected between Aldrin, Dieldrin and Gammalin, all of which gave good control. On the Endrin plots, however, capsid damage continued at an extraordinary low level. Insufficient control was obtained with Heptachlor.

This work is now being followed up in 1957: Endrin and Aldrin have been selected for comparison with the standard routine with BHC (as Gammalin); the former for its apparently outstanding performance, the latter for its relative cheapness. Large scale plots of 200 acres are being used, as well as smaller plots of 3 - 4 acres. On the smaller plots Malathion is being compared with Aldrin and Gammalin.

The experimental procedure is being made more rigorous. Untreated controls will be included for comparison with treated plots and allowances for variable tree density between different plots are being taken into account when trial assessments of the number of damaged trees per acre after spraying are made. For it is known that some experimental plots have three times as many trees per acre as others; if mere numbers of damaged trees per acre after spraying are used on the final assessment large errors between plots may occur, and the comparison of different insecticides rendered suspect. In addition pre- and post- treatment assessments of the amount of canopy is being made so as to assess its regeneration following various treatments. In all the above experiments dosages are at 4 oz. toxicant (in 5 gallons water) per acre applied with a Motoblo twice, with an interval of one month between.

MEALYBUG STUDIES

Joint WACRI and Department of Agriculture trials on mealybug control

The trials aiming at a control of mealybugs by the destruction of attendant ants continue: at Oyoko there is a 200 acre treated plot, with an untreated control of the same area and smaller areas are under observation elsewhere (see WACRI Quarterly Report No. 45). The observations are extremely detailed and attempt to assess the reduction in the mealybug

population and its rate of regeneration over the months following application of the spray (Dieldrin, 1 lb./acre applied, mistblown, to tree trunks): at the same time records are made also of the amount of activity and the level of the ant population, taking into account all the numerous species concerned. The most significant experiments are at W.A.C.R.I. and Oyoko. At Oyoko two to three months after spraying the mealybug population (P. njalensis counted up to hand height) had fallen to 1% of its former level, and this low level has been maintained now for 5½ months following the single spraying. Counts from whole trees show a slightly higher level for the total P. njalensis population (5.0-7.5% of original level).

All of this spectacular reduction cannot be attributed to the spray; for the experiments were made during a natural population decline. This was shown by the simultaneous reduction, soon after the spraying date, on the controls, although there is no possibility that the spray could have reached that area accidentally. The exact assessment of the effect of the spray on reducing the mealybug population is not straightforward and cannot be considered here; but there is no doubt that while over the last two months (i.e. 4 - 6 months after spraying) the mealybugs on the control area have increased consistently and rapidly, those on the treated area have maintained the very low level.

At W.A.C.R.I., a similar experiment has shown that whereas the P. njalensis population (counted on whole trees) declined after spraying to 6% of its former level, compared with a natural decline to 30% on the untreated plots, a low level of less than 15% (and usually less than 10%) has been maintained for about 4 months following the single application of Dieldrin. The control plot has shown a variable but generally high population level (from 100 to 15% of the original) except in the last two months (May - July) when a natural decline coincided with the rains.

In both these experiments ant populations have been assessed: but the correlation of ant activity with mealybug population levels has not been fully worked out.

POLLINATION STUDIES

The rates of pollination, setting and flushing throughout the year have been assessed in order to provide a background for the entomological aspects of pollination.

It was found that, for the year ending in May, 1957, peaks of flushing occurred in the experimental plots in October, December, January, February, March and May: and flowering was maximal at the end of March and the beginning of May, pollination and setting following the same pattern. The pollination rate of open flowers increased, from the end of June, to a maximum in November and December, dropping sharply to a minimum in March.

It is an interesting fact that certain individual trees did not follow this cycle but attained maximum flower production in October to December. In these trees the rate of setting was much higher than in the majority of trees which followed the common pattern: and this rate was positively correlated with the number of pollinating midges which occur in October to December. The time of maximum flower production in the crop did not, however, coincide with maximum numbers of pollinating midges. It remains to be seen if an increase in these would also increase rate of setting.

In an experiment made to assess the effects on pollination of routine anti-capsid spraying, a progressive decrease in the total numbers of insects visiting flowers was noted for 10 weeks after spraying (as compared with untreated controls): but no difference in pollinating rates on treated and untreated plots could be detected. Nor could any difference be detected in the effect on insect numbers of either of the two insecticides used, i.e. Dieldrin and gamma-BHC. at 4 oz./acre in 5 gallons water.

AGRONOMY DIVISION

Experimental areas

Normal routine operations were carried out, including further arboricide applications to those forest tree species which had survived the earlier treatment. Rapid total shade removal in the "no-shade" plots of the Shade and Manurial Trial gave the cacao a marked set-back, but with continued wet and dull conditions it is recovering.

Arboricides

A series of observations were started on twenty tree

species which are being treated with Phortox at two concentrations, either with or without frilling. Indications to date are that the heavier dosage applied to trees which have been frilled, is more efficient than the other three treatments.

BOTANY DIVISION

PLANT BREEDING AND SELECTION

During May and early June two small trials were planted at W.A.C.R.I., and four larger trials on Department of Agriculture stations at Fumso, Akaa, Buaku and Foso in Ghana. In Nigeria five trials were planted in Western Region, and two in Eastern Region.

The two trials at W.A.C.R.I. contain progenies raised from open-pollinated pods from the 9th Progeny Trial. One trial consists of eight square plots of 25 trees each, with the plots arranged in a line and the whole planting surrounded by guard-rows of Amelonado. Progenies from four of the 9th Progeny Trial varieties are involved, each variety being planted in two plots. The main object of this planting is to establish plots of these progenies, a second generation from our highly heterozygous hybrids, for general observation; but they have been arranged in such a way that they may give some indication of the degree of variation in performance to be expected between pods from the same tree, and between pods from different trees within a variety. Within a plot the 25 trees consist of 5 from each of 5 pods, arranged in a latin square. Where possible the 5 pods used in one plot consist of 3 from one tree and 2 from another.

When the planting holes were dug it was found that the top-soil varied in depth from virtually nothing to six inches or more. The holes were, therefore, scored visually to allow the performance of the trees to be compared to the depth of the soil. It is proposed also to plant Amelonado as seed-at-stake between the trees of the main planting, and take measurements of its rate of growth in an attempt to estimate the soil fertility. The Amelonado trees will be removed before they become large enough to compete seriously with the other varieties.

The second trial at W.A.C.R.I. compares progenies from

the varieties in the 9th Progeny Trial with the varieties themselves. It also compares seedlings of the varieties sown in 1955 with seedlings sown in 1956. This cacao is planted on a stream-side area of variable and generally very poor soil.

The trial consists of six randomised blocks each of nine plots, the plots being single rows of eighteen trees lying parallel to each other. The blocks are arranged three by two, and there is a guard row at the top and one at the bottom of the planting, the total planting being thus 54 trees by 20 trees. It has been possible to make five of the blocks reasonably inter-comparable, with seven types in common, but the sixth block has only three types in common with the other five blocks.

To designate a progeny from the Progeny Trial a 'P' has been placed in front of the code for its parent variety, thus the progeny from WBE6 is designated P.WBE6. To differentiate between a variety from a 1955 or a 1956 sowing the figures '55' or '56' have been added to its code, for example, WBE6/55 and WBE6/56. WBE6/55, WBE6/56 and P.WBE6 are included in all the five inter-comparable blocks, and WBE6/55 and WBE6/56 are also in the sixth block. The guard rows are planted with WBE6/56.

In the plots of progenies from the 9th Progeny Trial the eighteen plants consist, where possible, of two from each of nine pods. Records have been kept of the parent plant in each case, and of the date of sowing of the seed. The site used for this trial was previously a Herrania bulking area and to obtain an indication of the soil fertility the Herrania plants were cut down and weighed. A rough scoring of soil conditions was made when the planting holes were dug, but time did not allow a detailed recording.

In both these trials measurements are now being taken on the planted seedlings, so that their subsequent growth can be assessed accurately.

Series II Trials in Ghana

The Series II trials compare new hybrids corresponding to those in the 8th and 9th Progeny Trials at Tafo. Those planted this year are in randomised blocks, with nine replications and eight varieties, each plot being of sixteen trees arranged eight by two. The four trials include a total of nine W.A.C.R.I. Series II Varieties, of which four are common to all the trials, and the Akaa trial also includes an Amazon F2 type, T63. Of those which

are common to the trials planted this year, two are also common to the four planted last year, and the others to three of them. One common to the four planted last year is common to three of those planted this year. The trials planted last year had eight varieties each, but were planted in four replications with 36-tree plots arranged six trees by six.

The seedlings used in planting the trials were not all alike in size and age. Those of a particular variety were normally derived from four pods, which had matured and had been planted at different times. For the 16 trees within a plot, therefore, four were planted from each of four pods, and it was hoped that in this way any effects due to age variation could be detected and allowed for. This also ensures that the sample of a variety in one block is comparable to the sample in another block.

The use of small plots will increase the danger of a vigorous variety competing with a less vigorous variety in the neighbouring plot, resulting in the difference between the two varieties being over-assessed. If the plots were planted four trees by four, instead of eight trees by two there would be an inner group of four trees in each plot protected from competition from a neighbouring plot, but the value of such a small protected plot (4 trees) would be very small with cacao, in which wide tree-to-tree variation in performance is found. The eight-trees-by-two plots sample a greater part of the fertility variation within a block than would four-trees-by-four plots, and thus the former are more likely to have an average fertility near the average for the block. It is thought that the performance of a variety may be more accurately assessed in this way.

Previous experience has shown that in most West African cacao soils there are very wide local variations in soil fertility, so that compact blocks and a large number of replications are needed.

Trials in Eastern Region, Nigeria

A Series I trial inter-comparing Upper-Amazon types, and a Series II trial were planted at Bende, near Umuahia. The Series I trial was planted as a latin square of seven varieties, using 20-tree plots with the trees arranged 5 by 4. The Series II trial was planted with 6 varieties, in 12 randomised blocks, the plots being of 16 trees arranged 8 by 2. The plots of the Series II trial were arranged to the side of and below the Series I trial, and the whole area is to be surrounded by two guard-rows of Amazon cacao.

Trials in Western Region, Nigeria

In conjunction with the Department of Agriculture, sites for the Series I trials were selected at Fiditi, Ilesha and Ibule, and for the Series II trials at the Ibadan Native Administration farm, and Ibule.

It was decided to plant nine of the W.A.C.R.I. Series I varieties into each Series I trial. Of these, seven are common to all three. It was also decided to include two types at present being issued to farmers in each trial for comparison - the mixed Upper Amazon types referred to as 'Departmental Amazon', and a hybrid T38 x CF176. As this increased the number of varieties in each trial to eleven, an incomplete block design is being used. This presents a problem in that should any plots be severely damaged, the whole trial design falls to pieces statistically, whereas with a randomised block design only the particular block or variety in the plot is affected. Damage to plots by falling trees is all too common in cacao, and these trials will need especially close attention.

The Series II trials were planted with six W.A.C.R.I. Series II varieties, of which four are common to both. For comparison 'Departmental Amazons' were included in each, and a W.A.C.R.I. Series I variety was planted into the I.N.A. trial. These trials were planted as randomised blocks.

Quality

Samples of cocoa from the hybrids WEB2, WBE2, WBE3, WBE4, WAE3 and WAE5 have been assessed as 'within the West African flavour range' by Messrs. Cadbury Brothers. WBE2 and WBE3 have very similar parentage and were fermented and assessed together. Messrs. Cadbury Brothers commented that some of the beans of WBE4 showed evidence of Criollo-type parentage in their appearanc

Samples are shortly to be submitted to the Cocoa Scientific Advisory Committee, and to the United States manufacturers, for official assessment.

Seed Gardens

The Department of Agriculture, Ghana, have planted the first two seed-gardens with cuttings of Nanay 32 and Parinari 35, the parents of T63 and T82. The seed from these gardens will be equivalent to that from which the trees in the Trinidad Introductions were obtained.

VEGETATIVE PROPAGATION

Fertilizer on cuttings

In this experiment (see Quarterly Report No. 44), after six months there has still been no response to the fertilizers applied, and the experiment has been discontinued.

Following normal practice at W.A.C.R.I. the cuttings used in this work were set in top soil taken from the forest. Since most of the soil's fertility is found in the top six inches it is not altogether surprising that no response has been observed although the lack of response to nitrogen over the whole period was unexpected. Nitrogen is the major element required by the plant and it would be expected that as the cutting gets larger and the soil in the basket progressively more leached (due to continued watering) nitrogen application would be advantageous.

In Quarterly Report No. 45 mention was made of the deleterious effect of the initial application of nitrogen (which was incorrectly quoted at 1.5 gm. of urea per basket instead of 0.5 gm.). It is possible that this may have had a lasting effect on the plant and an experiment is being planned which will investigate the effect of nitrogen applications at different levels in the light of this experience.

Nutrient uptake by cacao in water culture

Preparations are being made for an experiment to test the effect of different culture solutions on the growth of seedlings between the age of 3 and 15 months. The composition of the solutions will be based on those used by M. Homes in his sand culture experiments (I.N.E.A.C. publication, 1953). The experiment will involve the use of large quantities of mineral-free water and some time has been spent in constructing a demineralising apparatus using ion-exchange resins to prepare such water. This method is better than that involving the distillation of tap water in that it produces demineralised water more rapidly and more conveniently. It is also much cheaper and, given suitable refinements, provides water of a greater purity. As measured by electrical conductivity the demineralised water being produced from this apparatus contains considerably less impurities than that found in ordinary glass-distilled water.

An experiment is in progress to determine the visual symptoms obtained when different minor elements are omitted from the nutrient solution. This type of experiment has been done in the past by Greenwood and Djokoto (1952) at this station

and by several other workers elsewhere, but there are slight differences in the symptoms described and there are no photographs in colour generally available. Greenwood found no difficulty in obtaining symptoms of deficiency of the trace elements using only AnalaR grade chemicals, although purification of these is usually necessary. The same grade of chemicals has been employed in this experiment but although it has been in progress for three months no deficiencies, with the exception of iron, have yet been obtained. Accordingly, more refined methods are to be employed starting with the use of the demineralised water mentioned above and the preparation of calcium nitrate, which is not supplied direct in a purified grade, from AnalaR reagents.

The seedlings which were transplanted into water culture solution when they were six months old are now almost a year old (see Quarterly Report No. 45). They are growing rapidly and are now considerably superior to a control growing under relatively poor conditions in ordinary soil in a concrete pot. It remains to be shown that seedlings growing in the field can be successfully transplanted.

CHEMISTRY DIVISION

SOIL FERTILITY

Effect of major nutrients on cacao

For the manurial trial on mature Amelonado cacao (see Quarterly Report No. 45) six sites in Ashanti have been marked out, and fertilizers were applied at the beginning of May.

Applications of fertilizers were also made in May to the four-year old Amazon cacao in the 2^4N,P,K,Mg experiment at Apedwa, and to the Amazon cacao in the 2^3 N, P, K trial at Bunso.

The Shade and Manurial Trial on the Square Mile was given an NP dressing of fertilizer in May. The fertilizer treatments have been modified, and no more K or Mg will be applied this year.

A new Amazon seedling establishment experiment was started on Plot 18C at Bunso. Designed as a 2^4 N, P, K, Mg experiment, the trial covers an area of 6.4 acres, and is thus the largest fertilizer experiment yet attempted by W.A.C.R.I.

In July a 2^2 fertilizer-mulch experiment was started on the Square Mile on land which had been exposed for a considerable time. The cacao consists of mixed Amazon seedlings.

Other field experiments

In the investigation of soil fertility on clear-felled land a second application of elephant grass mulch was made in July.

Routine recording of soil temperatures and moistures has been started on the Soil Exposure Experiment. Soil samples are taken each month for chemical and physical analysis.

An intensive soil and vegetation survey has been carried out in a "Sickle Leaf" area at W.A.C.R.I.

Pot experiments

The application of fertilizer to seedling cacao growing in pots has continued. The present experiment will be concluded in July.

COCOA PREPARATION AND QUALITY

The results of experimental work done on the 1956-57 main crop are being prepared for publication.

Work on the mid-crop is being devoted entirely to the application of the results obtained from small scale experiments to large scale or production fermentation. It is intended to apply the results of this study to the design of the fermentation vessels which will be used in the new fermentation block.

IBADAN SUB-STATION

PATHOLOGY SECTION

The effect of the presence of Calonectria rigidiuscula (Berk & Br.) Sacc. in coppiced stumps, on the regeneration of Theobroma cacao L.

The results from coppicing experiments at I.N.A. showed that trees "alive at the base only" gave the lowest percentage of regeneration. With some of these trees an area of "die-back" had extended below the line of coppicing and fungal infection was active within the coppiced stump. In the analysis of failures it was not possible to separate deaths resulting from fungal damage from those due to loss of vigour in a tree "alive at the base only."

It was considered that the presence of Calonectria rigidiuscula (Berk & Br.) Sacc. within the stump may have affected regeneration and an experiment has been started at Agodi Cocoa Farm, Ibadan, to see the effect on regeneration of implanting

C. rigidiuscula in the coppiced tree stump. Ninety trees were coppiced in June (Wet Season) and ninety will be coppiced in December (Dry Season). The trees coppiced were selected from three groups; those possessing some fan canopy, those without fan canopy and with only the main trunk alive, and those alive at the base only. In each of these groups, ten trees were selected as controls and twenty for treatment, ten of which were treated in the sap-wood and ten in the heart-wood. Sterile wooden plugs bearing active C. rigidiuscula growth, were hammered into three holes, each one-inch deep, bored in the coppiced stump. In the sap-treated stumps, the holes were bored on the southern aspect of the stump immediately behind the bark, with half an inch between the holes. In the heart-treated stumps, the central hole was bored in the middle of the stump with the other holes half an inch away on either side.

Observations will be made to see the effect of C. rigidiuscula infection on cushion and chupon development and on completion of the experiment, on the growth of C. rigidiuscula in the coppiced stump.

ENTOMOLOGY SECTION

Chemical Control of Capsids

Control of the experiment on the use of BHC against cacao capsids, which had been run jointly by W.A.C.R.I. and the Department of Agriculture, Western Region, Nigeria for a year, was handed over to the Department. Suggestions for the simplificatio of the system of record keeping in this experiment and for the replacement of some of the least effective treatments by other treatments likely to give economical control of those pests, were made and discussed with Officers of the Department.

Cacao pests in the Southern Cameroons

In view of the claims that applications of BHC gave some control of the condition known as "Leafless Twig Disease" of cacao in the Southern Cameroons a brief visit was made to this area in June. Cacao Psyllids (Tyora tessmanii (Aulm.)), which had been suggested as causing the disease, were not particularly numerous at this time and were found to be more abundant on normal flush shoots than on the leafless twigs

typical of the disease. Mites and Aleyrodidae were found more frequently on the latter. Although no definite conclusions could be drawn as the result of so short a visit several lines of investigation suggest themselves and it is hoped that it will be possible to pursue these during a longer visit later in the year.